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ABSTRACT

This unit of instruction on drawing and sketching in agricultural mechanics is designed especially for use with freshman vocational agriculture students. A unit plan discusses the general aims and goals, lesson titles, student and teacher activities, a list of necessary special equipment and references. The unit consists of nine lessons. A lesson plan for each lesson provides these components: need; references; objectives; interest approach; an outline of key questions, problems, and concerns with appropriate teaching techniques and information; application and followup; and transparency masters, exercises, handouts, and/or worksheets. Lesson topics are: drawing and sketching, tools and equipment used in mechanical drawing, procedures used in agricultural drawing and sketching, lettering, drawing to scale, multiview drawing, dimensioning of drawing, reading and interpreting plans, and figuring a bill of material. (YLB)

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DRAWING AND SKETCHING IN AGRICULTURAL MECHANICS

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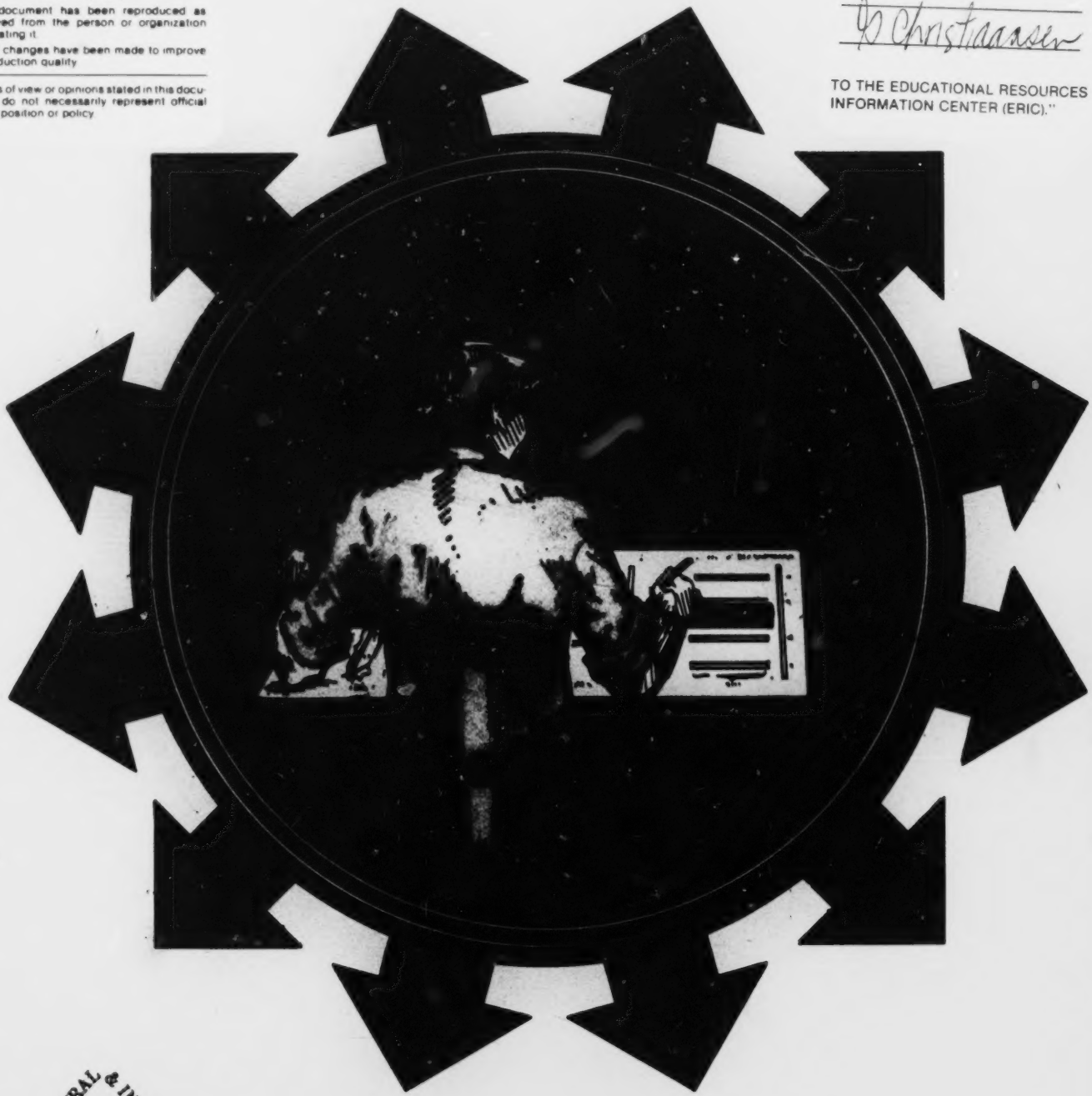

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Agricultural & Industrial Education, Montana State University, Bozeman

1986 Revision

DRAWING AND SKETCHING

IN AGRICULTURAL MECHANICS

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Montana State University
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FOREWORD

This unit of instruction has been designed especially for use with freshmen vocational agricultural students. For your convenience, the material has been prepared to fit into a three-ring, loose-leaf notebook. Other material that is developed to accompany this unit of instruction will be prepared in a similar manner.

The instructor should study the entire unit carefully before attempting to teach any of the lessons. The key concepts that should be presented to meet the objectives of the core curriculum are included. However, all material that would be applicable may not be provided. Each instructor should look for ways to include other activities and examples where possible and appropriate.

Some handouts and visual materials are included with each lesson. Here again, each teacher may have additional illustrative material that would be appropriated or similar.

It is important to have several references available. Some references are listed with each lesson, but there are many other references that could be used with this instructional material.

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UNIT PLAN

Unit: Drawing & Sketching in Agricultural Mechanics

Situation:

Construction projects have been a part of vocational agriculture since the beginning of the program. The construction project has been used to teach numerous skills as well as support the student's SOE program or improve the operation of the home, farm, ranch or agribusiness.

Planning for these projects, drawing or sketching the project and figuring the amount and cost of materials required are important skills to be taught early in the student's vocational program. With the cost of materials continuing to rise, these activities become a more critical part of the student's basic knowledge and skill.

Aims and Goals:

1. To understand the steps to take in planning for a construction project.
2. To identify resources useful in planning a project.
3. To determine project costs.
4. To understand the principles of drawing and sketching.
5. To demonstrate the use of drawing and sketching equipment.
6. To understand lettering.
7. To read and interpret simple plans.
8. To calculate bills of materials.
9. To use and explain the reasons for different types of drawings.
10. To understand dimensioning.
11. To recognize the common symbols used in drawing and sketching.

Lessons:

1. Drawing and Sketching
2. Tools used in Drawing and Sketching
3. Procedure used in Mechanical Drawing
4. Lettering

Lessons, Continued:

5. Drawing to scale
6. Multiview Drawing
7. Dimensioning
8. Reading and Interpreting Plans
9. Bill of Materials

Student Activities:

1. Demonstrate the proper use of tools and equipment used in drawing and sketching.
2. Complete lettering exercises.
3. Complete scaling problems.
4. Draw multiview drawings.
5. Prepare a bill of materials.
6. Identify dimensions from a blue print.

Teacher Activities:

1. Gather drawing equipment needed.
2. Obtain blueprints of some common objects.
3. Prepare small wood blocks of varying shapes for drawing practice.

Special Equipment

1. Drawing boards and t-squares.
2. Various types of drawing pencils.
3. Masking tape, erasers, protractors, dividers, triangles and architect's scale.
4. Numerous wooden blocks of different shapes.

References:

Jones, Mark W., Shopwork on the Farm, McGraw Hill Book Company, Inc.

Phipps, Lloyd J., Mechanics in Agriculture, The Interstate Printers and Publishers, Inc.

Shinn, Glen C., and Weston, Curtis R., Working in Agricultural Mechanics, Gregg Division, McGraw-Hill Book Company, 1978.

Wakeman, T.J., Modern Agricultural Mechanics, The Interstate Printers & Publishers, Inc.

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 1: Drawing and Sketching

Need:

No one can do an efficient job of project construction unless they have a good idea of what the final project will look like. This is particularly true if the project has some unique design features. A good plan on paper will help a worker overcome mechanical and construction problems while helping save time, money and material. A good plan becomes a guide throughout the project. Thus, it becomes important to learn the basic skills used in mechanical drawing.

References:

Modern Agriculture Mechanics, Wakeman.
Working in Agricultural Mechanics, Shinn and Weston

Objectives:

1. Given an example of a drawing and a sketch, the students will be able to identify the characteristics and uses of each and tell when each will be used.

Interest Approach:

Provide a plain, unlined sheet of paper for each student and a common object found in the department such as a screwdriver. Ask the students to sketch the screwdrivers. Discuss with them the problems they might be having. Then give the students a sheet of paper such as graph paper with small squares already drawn. Then have them sketch the same object. Does it make the task easier?

Key Questions, Problems or Concerns	Teaching Techniques and Procedures
1. Why learn to sketch?	a. A means of expressing your ideas. b. An aid to verbal language. c. Helps to clear up our ideas. d. Show others what you have in mind. e. Can be used when time is not available to make a finished mechanical drawing.

2. What equipment is needed?

a. Pencil.
b. Soft eraser.
c. Paper (Cross-section paper).

3. How do you sketch horizontal lines?

a. Mark off two points. Make the dots parallel to the top or bottom edge of the paper.

b. Move your pencil back and forth to connect the dots with a construction or guide line.

c. Start from the left and draw an object line over to the construction line.

d. Have the students practice. It may be helpful to use OH 1.

4. How do you sketch vertical lines?

a. Make two dots spaced a distance equal to the length of line to be drawn. Make the lines parallel to the right or left edge. Move the pencil back and forth to make a construction line.

b. Start from the top point and sketch down to produce an object line over the construction line.

c. Vertical lines can be sketched by rotating the paper from a vertical to a horizontal position.

d. Have the students practice. It may be helpful to use OH 2.

5. How do you sketch inclined lines?

a. Mark off two points at the desired angle. Connect the points by moving the pencil back and forth from left to right.

b. Sketch an object line over the construction line. Sketch up when the line is inclined to the right. Sketch down when the line is inclined to the right.

c. You may want to rotate the paper until the points are in a vertical position.

6. What is Mechanical Drawing?

a. The drawings are made with drawing instruments.

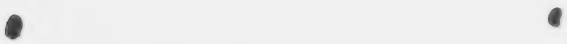
b. The lines are scaled to the dimensions of the actual objects.

c. Drawings are made up of:
   1. Lines
   2. Dimensions or sizes
   3. Symbols

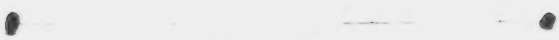
Application and Followup:

Provide the students with some sectional paper and some simple objects to practice sketching. Remind the student that it is easier for some persons because of varying artistic ability. It might be helpful for the students to make freehand sketches of some of the required projects they will be completing.

HOW TO SKETCH A HORIZONTAL LINE



STEP 1



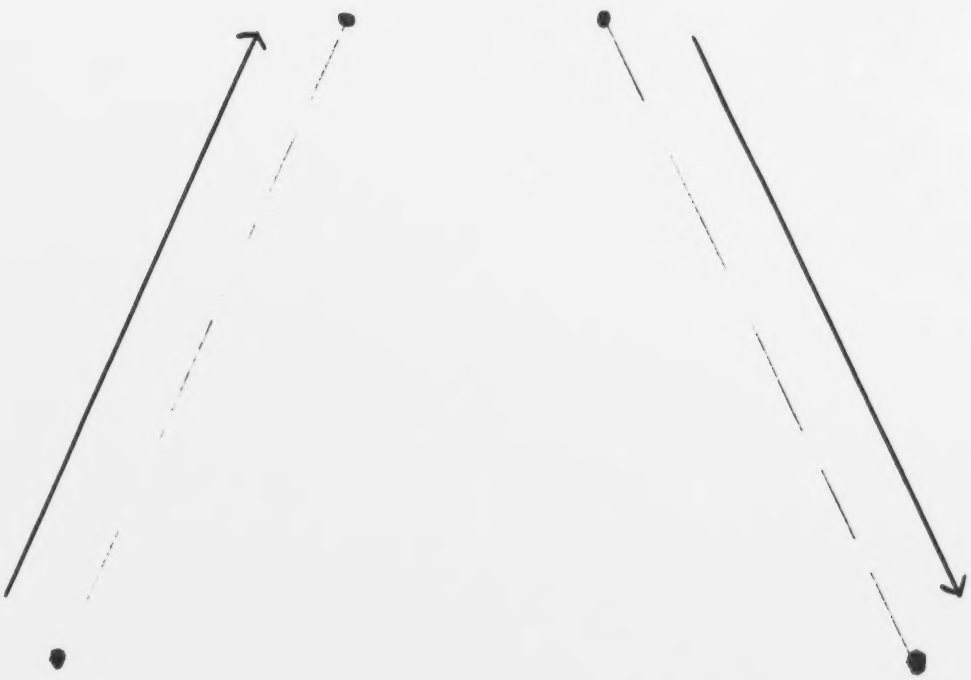
STEP 2

STEP 3

HOW TO SKETCH A VERTICAL LINE

STEP 1 STEP 2 STEP 3

HOW TO SKETCH AN INCLINED LINE



UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 2: Tools and Equipment Used in Mechanical Drawing

Need:

To be good at doing anything one must be able to use tools and equipment properly. One does not have to be an artist to prepare excellent drawings. However, it is important to know when, how, and where to use the tools properly. Because the tools are quite fragile they must be handled with care if they are to be used to make accurate drawings.

References:

Modern Agricultural Mechanics, Wakeman
Working in Agricultural Mechanics, Shinn and Weston
Shopwork on the Farm, Jones

Objectives:

Given the actual tool or piece of equipment or a picture, the students will name the tool or piece of equipment and describe how it is used when doing mechanical drawing.

Interest Approach:

Show the students how much easier it is to make a straight line with a T-square than it would be freehanded. It may be interesting to have a student draw a 45 degree angle freehanded and then check it with a protractor. Be sure all tools and equipment are available to be shown during the lesson.

Key Questions, Problems, and Concerns	Teaching Techniques and Procedures
1. What are the most common tools used in mechanical drawing.	a. Drawing board (OH 1) 1. Made of softwood which is smooth and will retain its shape. 2. A 20" by 26" board is suitable for most drawing. 3. The edges of the board must be straight. 4. A piece of heavy paper may be taped to the board to protect the surface.

b. T-square (OH 1)
   1. This square is made in two parts.
   2. The better quality squares have plastic embedded in the blade.
   3. The head of the T-square slides along the edge of the drawing board.
   4. It is used to draw horizontal lines and support triangles used to draw vertical lines.
   5. The head of the square must be held firmly against the drawing board.
   6. Note: Illustrate and have the students use the T-square.

c. Triangles
   1. When supported on the blade of the T-square they are used to draw vertical and inclined lines.
   2. They are made of transparent plastic.
   3. You can purchase a 30-60 degree triangle and 45 degree triangle.
   4. By combining the triangles, different angles can be drawn.
   5. Use OH-2 to illustrate the use of the triangles.

d. Compass, Dividers (OH 3)
   1. Used to draw circles and areas.
   2. The compass can be used as a divider by replacing the pencil with a pin.
   3. Dividers are used to transfer measurements and spacing from one part of a drawing to another.
   4. To set, draw a line equal to the length of the desired radius.
   5. Be sure to illustrate how to hold and use the compass.

e. Protractor (OH 3)
   1. Used to measure angles.
   2. It has degree graduations around its circumference.
   3. To measure:
      a. Place flat edge on the blade of the T-square.

b. Place the center line of the protractor on the point of the desired angle.
c. Mark the proper degree from the graduations.

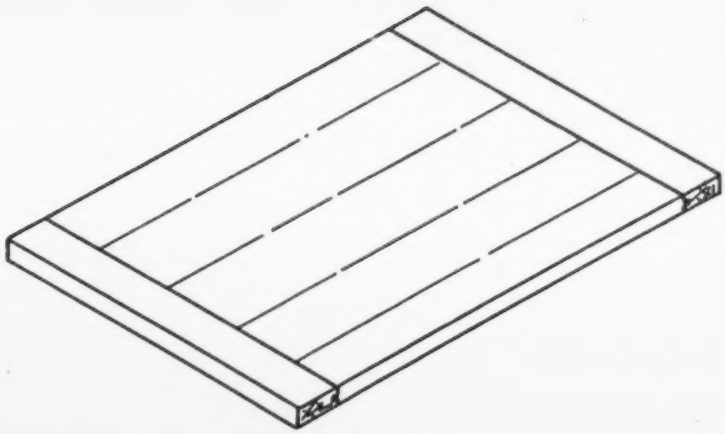
Note: Give the students the practice sheet in determining angles.

f. Other items needed. (OH 4)
1. Pencil pointer
a. Used to keep pencils sharp.
b. They usually have fine sandpaper on one side and felt on the other.
c. The felt is used to wipe off graphite.
2. Masking tape
a. To attach paper to drawing board.
2. Use sparingly
3. Erasing Shield
a. Can erase small mistakes without soiling large areas.
b. Available in metal and plastic.
4. Dusting brush
a. To remove rubber crumbs or loose dirt particles from the drawing.
b. Don't brush anything else in that might damage the bristles.
5. Erasers
a. Art gum and rubber erasers are most commonly used.
b. After erasing, always brush crumbs away before drawing.
6. Pencils
a. Available in 17 degrees of hardness from 6B (very soft) to 9H (very hard).
b. Soft pencils smear easily.
c. Use 4H or a 5H for layout work and dimension lines.
d. Use an H or 2H to darken the lines and for lettering.
e. Illustrate the effect of using different pencils
7. Scaler (Discussed in Lesson 5)

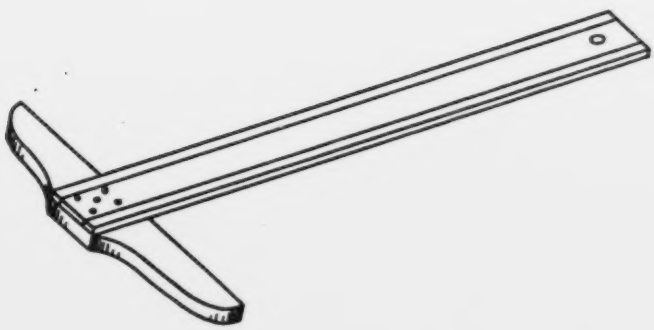
Application and Followup:

Place the name of the drawing tool in a container. Have the students draw out the name of a tool. Ask them to explain and demonstrate the use of the tool in drawing.

DRAWING TOOLS

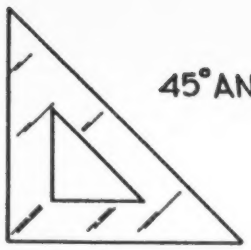


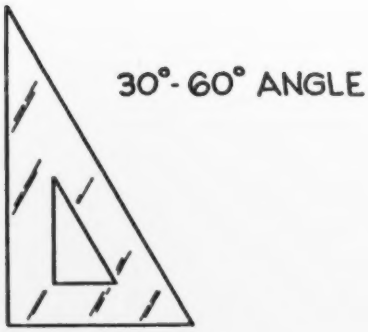
DRAWING BOARD

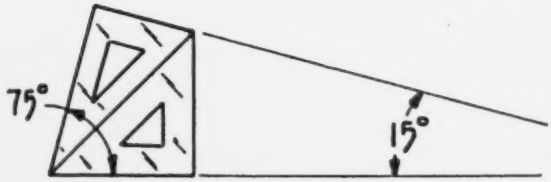


T-SQUARE

DRAWING TOOLS

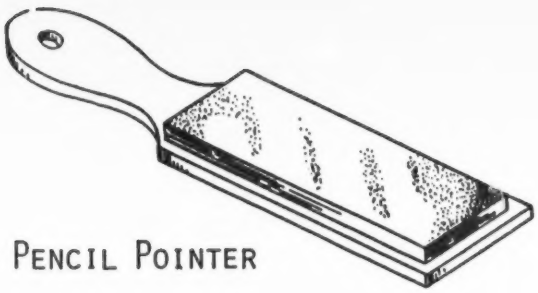




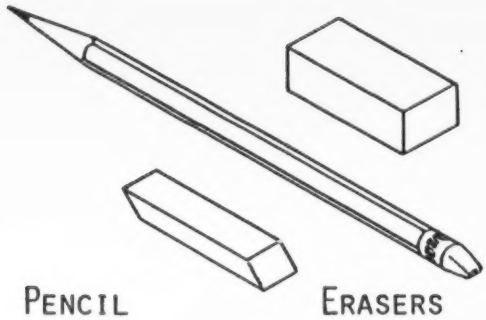


ANGLES USED IN COMBINATION

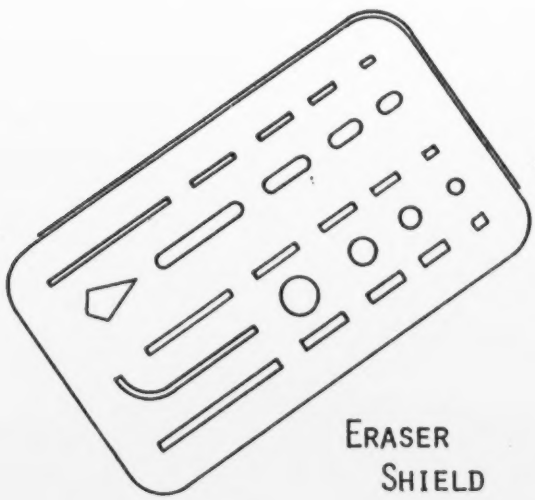
DRAWING TOOLS



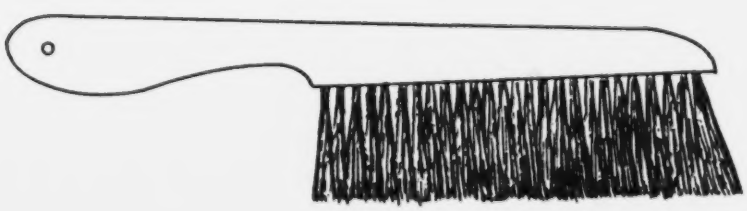
PENCIL POINTER



PENCIL ERASERS



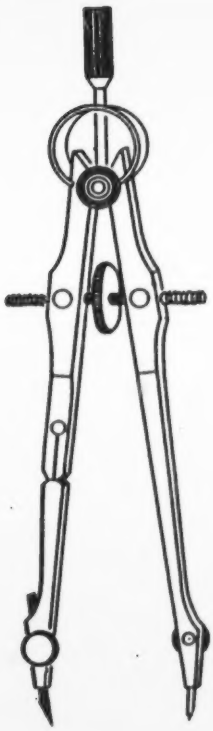
ERASER SHIELD



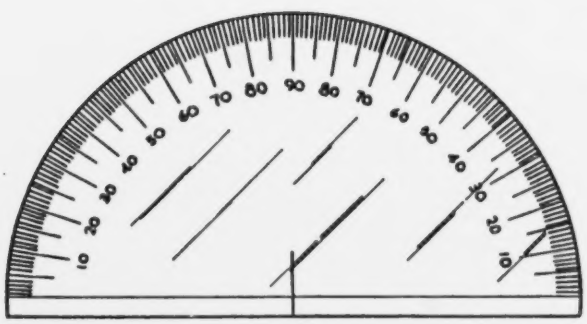
DUSTING BRUSH

DRAWING TOOLS

THE ELLIPTICAL POINT



COMPASS



PROTRACTOR

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 3: Procedures Used In Agricultural Drawing and Sketching

Need:

There are certain accepted and established procedures that are unique to drawing and sketching. A thorough knowledge of these procedures will enable the student to do quality work. Proper use of the procedures will reduce the chance of error.

References:

Modern Agricultural Mechanics, Wakeman
Working in Agricultural Science, Shinn and Weston
Mechanics in Agriculture, Phipps

Objectives:

1. Given the basic drawing and sketching tools the student will be able to:
   a. Name and draw lines used in drawing and sketching.
   b. Properly attach the paper to the drawing board.
   c. Draw in margins.
   d. Prepare a title block.
   e. Center a drawing.

Interest Approach:

Show the students a drawing of a project that is well done, clean, neat and easy to follow, and a drawing of a project that leaves much to be desired. Have the students give their perceptions of the two drawings relative to their usefulness in constructing the project.

Key questions, problems, and concerns	Teaching techniques and procedures
1. What lines are included in the "alphabet" of lines?	a. Using the attached form (handout #1) have the student complete the chart on the alphabet of lines. b. Discuss the chart when they have completed their work. c. Use OH-1 during the discussion.
2. What is the proper procedure for attaching drawing sheet to the board?	a. Use OH-2 while illustrating the procedure for the students.

3. What are the standard border dimensions?

   a. A 1/4" margin is usually used on an 8 1/2" x 11" sheet.

   b. A 1/2" margin is usually used on an 17" x 22" sheet.

   c. The title block at the bottom of the page is generally 5/8" wide.

   d. On a 17" x 22" sheet, the title block is usually in the right hand corner and is three inches (3") long and two inches (2") wide.

   e. Distribute handout #2.

4. How do you lay out a border on an 8 1/2" x 11" sheet?

   a. Steps in laying out a border
      1. Attach the drawing page to the board.
      2. Make a short light pencil mark 1/4" in from the edge of the paper.
      3. Using a T-square, complete the border around the entire sheet.
      4. Draw a 5/8" wide title block on the bottom of the sheet.
      5. Divide the title block into 3 equal parts.
      6. To do this, place the scale on a diagonal with the first measuring mark on the left vertical line and the 12" mark on the right border line. Lightly mark at 4" and 8" mark. This will divide the area into 3 equal parts.
      7. Draw in the guide lines on the title block.

Application and Followup

Provide the students with the necessary equipment and materials and have them prepare a sheet to include the borders and the title block.

ALPHABET OF LINES

Line	Example and Description	Use	Weight
1. Construction & Guide Line		Used to block in drawings. Used as a guide for lettering.	Very light.
2. Border Line		Used to draw the border and outline the title block. To frame a drawing.	Heaviest of all lines.
3. Visible object Line		Used to outline the edges of an object that can be seen.	Heavy
4. Hidden object Line	Short lines 1/8" long separated by 1/16" spaces.	Used to represent edges of an object hidden from view.	Medium
5. Dimension Lines	5"	Capped on each end with an arrowhead.	Light
6. Extension Line		Used to extend the dimensions beyond the outline of a view. Starts 1/16" beyond the object and extends about 1/8" beyond the last dimension line.	Light
7. Center Line		Alternate 3/4" and 1/8" dashes with 1/16" space between.	Heavy line
8. Cutting Plane Line		Used to donate where the sectional view will be taken.	Heavy line
9. Short Break Line		To indicate short breaks.	Heavy
10. Long Break Line		To indicate long breaks.	Light
11. Section Lines		Used when drawing inside features of an object. They indicate material cut by the cutting plane line and also indicate the general classification of material.	Fine dark Lines

17

THO

ATTACHING THE SHEET TO THE BOARD

1. CLEAN THE BOARD OF ALL ERASER CRUMBS AND DIRT. PLACE THE PAPER IN THE UPPER LIFT HAND CORNER OF THE BOARD ABOUT 2 IN. FROM EACH EDGE.

2. CLEAN THE T-SQUARE AND PLACE IT ON THE BOARD WITH THE HEAD FIRMLY AGAINST THE LEFT EDGE OF THE BOARD.

3. SLIDE THE T-SQUARE UNTIL THE BLADE IS IN LINE WITH THE TOP EDGE OF THE SHEET. MOVE THE PAPER UNTIL THE EDGE IS PARALLEL WITH THE BLADE AND ATTACH THE SHEET. SOME SHEETS MAY REQUIRE FASTENERS ON THE BOTTOM CORNERS.

4. ANOTHER METHOD THAT IS SOMETIMES USED IF THE SHEET IS SMALL ENOUGH, IS TO PLACE THE HEAD OF THE T-SQUARE FIRMLY AGAINST THE LEFT EDGE OF THE BOARD AND SLIDE IT INTO POSITION. THE BOTTOM EDGE OF THE SHEET IS PLACED AGAINST THE BLADE OF THE TOOL. ATTACH THE SHEET TO THE BOARD.

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 4: Lettering

Need:

Neatness, accuracy and clarity are extremely important in sketching and drawing. All three of these characteristics are, to some extent, dependent on neat, uniform lettering. Freehand lettering requires a lot of practice.

References:

Modern Agricultural Mechanics, Wakeman.

Objectives:

Given a standard size piece of drawing paper with guidelines, the students will draw freehanded, upper and lower case vertical gothic alphabet, numbers and fractions according to the guidelines given.

Interest Approach:

Have two or three students draw a series of numbers and letters on the board. No doubt there will be differences. Discuss with the students the importance of uniformity in order to be sure that everyone has the same interpretation. Discuss how a slight misunderstanding could cost a large sum of money and a loss of a great deal of time.

Key Questions, Problems or Concerns	Teaching Techniques and Procedures
1. Why is accurate lettering so important?	a. Lettering supplements the graphic description. b. It enhances the appearance of a drawing.
2. What skills must one learn to master lettering?	a. Learn the proper strokes. b. Learn the basic shapes. c. Learn the proper spacing. d. Practice. e. Use OH 1 to illustrate the skills.
3. What equipment is needed for lettering?	a. H or 2H pencil for lettering. 4H or 6H pencil for drawing guidelines, standard ruler, T-square, sandpaper block.

4. What rules should be followed when lettering?

a. Guidelines
   1. Always use guidelines.
   2. They should be drawn with a "needle sharp" 4H or 6H pencil.
   3. Draw the lines very lightly.

b. Spacing
   1. There is no hard and fast rule on how far apart to place the letters.
   2. The spacing between letters should be judged by the eye.
   3. The spacing between words should be equal to the height of the letters.
   4. The spacing between sentences should be equal to twice the height of the letters.

c. Height of the lettering.
   1. Letters and numbers are usually 1/8" high with 1/8" spacing between lines.
   2. Titles are usually 3/16" to 1/4" high.
   3. Numbers are the same height as letters.
   4. Fractions are twice the height of the letter.
   5. Use OH 2.

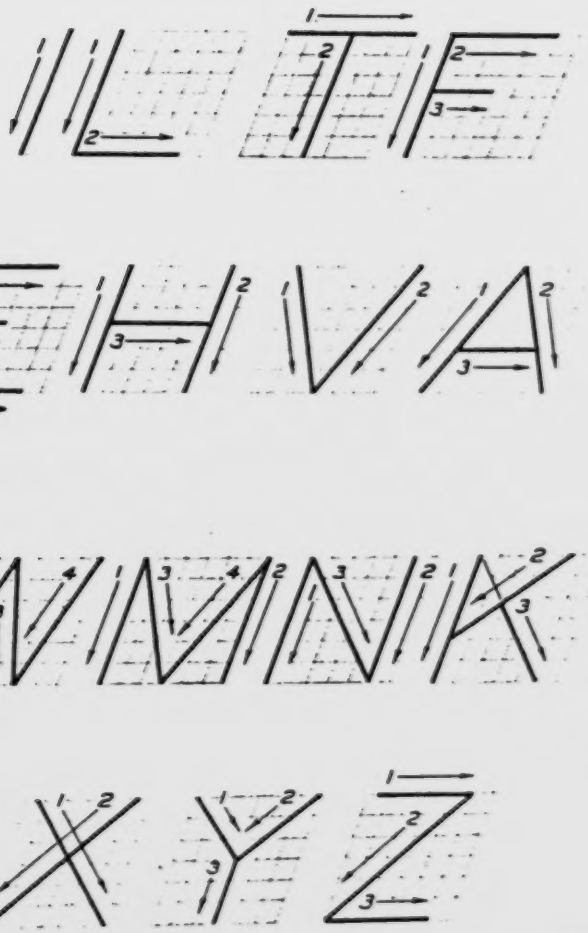
d. Uniformity.
   1. The main requirement for good lettering.
      a. Never mix capitals and lower-case letters.
      b. Use guidelines to prevent irregularities.
      c. Avoid thick and thin strokes.
      d. The background area between letters should appear equal.
      e. The space between words should not be too small but should be about equal.

   2. Use OH 3.

Application and Followup:

Provide the students with the necessary materials in order that they might practice making letters, numbers and fractions. Have the students make both upper and lower case letters. To get the students started, you might want to provide them with proper paper on which the guidelines are already drawn. A lettering exercise is attached to this lesson.

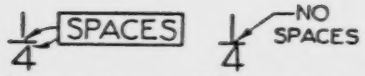
LEARN THE PROPER STROKES



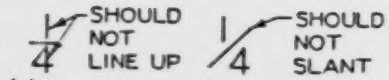
DRAW YOUR FRACTIONS CORRECTLY

$4\frac{1}{2}$ $1\frac{7}{16}$ $\frac{1}{4}$

$\frac{3}{8}$ $5\frac{9}{32}$ $\frac{3}{4}$



(a) CORRECT (b) WRONG



(c) WRONG (d) WRONG

UNIFORMITY IN LETTERING

RELATIVELY

Relatively — Letters not uniform in style.

RELATIVELY
RELATIVELY — Letters not uniform in height.

RELATIVELY
RELATIVELY. — Letters not uniformly vertical or inclined.

RELATIVELY
RELATIVELY — Letters not uniform in thickness of stroke.

RELATIVELY — Areas between letters not uniform.

NOW IS THE TIME FOR EVERY GOOD MAN TO COME TO THE AID OF HIS COUNTRY — Areas between words not uniform.

Lettering Practice

Practice printing the following numbers and fractions: 1 2 3 4 5 6 7 8 9 10 $\frac{1}{2}$ $\frac{7}{16}$ $\frac{3}{8}$

Practice printing the following letters: THE QUICK RED FOX JUMPED OVER THE LAZY BROWN DOG

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 5: Drawing to Scale

Need:

Often, the objects that must be drawn will not fit on the normal size paper if drawn to full size. Furthermore, it would be unrealistic to draw large objects to full scale. By knowing how to use an architect's scale one can save time, space, and prepare neat readable drawings that are easy to follow when building the project.

Reading Assignment:

Modern Agricultural Mechanics, Wakeman

Objectives:

Following the lesson presentation and demonstrations, the students will be able to:

1. Select an appropriate scale for the project being drawn.

2. Demonstrate their ability to read an architect's scale.

Interest Approach:

(Use OH 6&7 to review reading of the common ruler.) Show the students a simple, but rather large object or project they will be expected to build. Their task will be to draw the outline of the object or project on an 8 1/2 x 11" piece of paper showing the drawing is properly proportioned. Let them explain how they will do it and what they will use to accomplish the task.

Key questions, problems concerns		Teaching techniques and information
1. What is an architect's scale?	a.	A specially designed scale ruler that is used to reduce the size of an object so it can be drawn on a standard size paper or enlarge an object that may be too small to interpret.

2. What is the main function of the architect's scale?

a. It enables the person to think in relation to the actual size of the object or structure and convert these measurements into smaller values for illustration purposes.

b. Use OH-1 to explain and discuss the function.

3. Examine the different types of scales.

a. Show the students a triangular architect scale.

1. Point out that the scale has a full scale of 12" which is graduated into 16 parts to an inch.

2. Point out the ten other scales (two on each face)
3/32, 1/8, 3/16, 1/4, 3/8, 1/2, 3/4, 1, 1-1/2, and 3.

3. Two scales are located on each face.
   a. One scale reaches from left to right
   b. The other scale on the same face is twice as large and reaches from right to left.

   Example: 1/4" scale and 1/8" scale are on the same face, etc.

   Note: When reading a scale, be sure you are reading in the right direction.

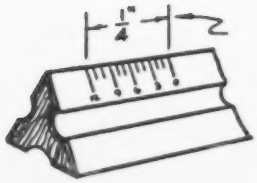
   c. Illustrate these concepts to the student using an architect's scale.

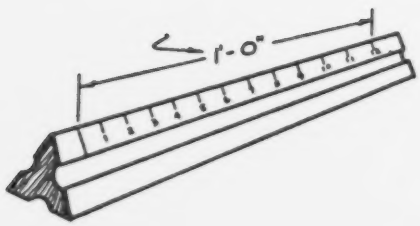
4.	What factors should we consider when selecting a scale?	a. Selecting the proper scale is sometimes difficult. Consider: 1. The size of the object. 2. The size of paper. 3. The details to be shown. 4. Appearance of the object.
5.	How do you use the architect's scale?	a. The scale is only as accurate as the person using it and the sharpness of that person's pencil. b. Use OH 2 & 3 to illustrate the function of the scale.
6.	Key to measuring correctly with a scale.	a. Start with the zero line, not the fully divided section. b. Always start with the number of feet you must measure. c. Add additional inches in the subdivided area (Use OH-4)

Application and Followup:

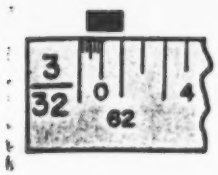
Prepare handout one for the students to test their skill in using the architect's scale. For additional practice you can prepare other objects to measure.

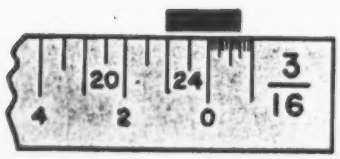
1/4" MAY REPRESENT 1' = 0" ON A DRAWING

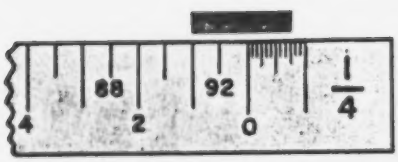


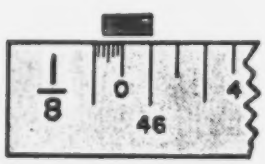


1′ 9″ AS IT APPEARS ON SEVERAL ARCHITECT'S SCALER.

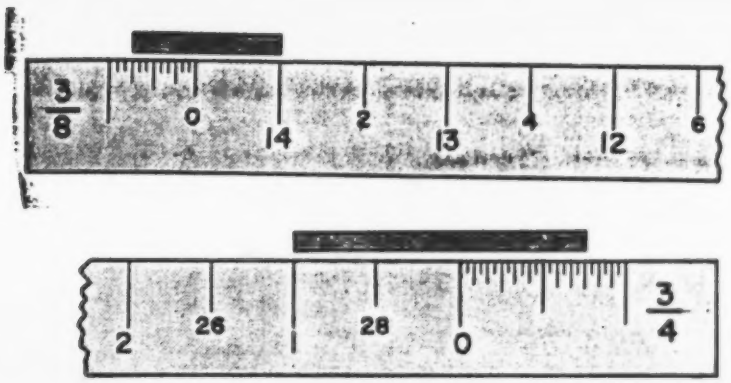


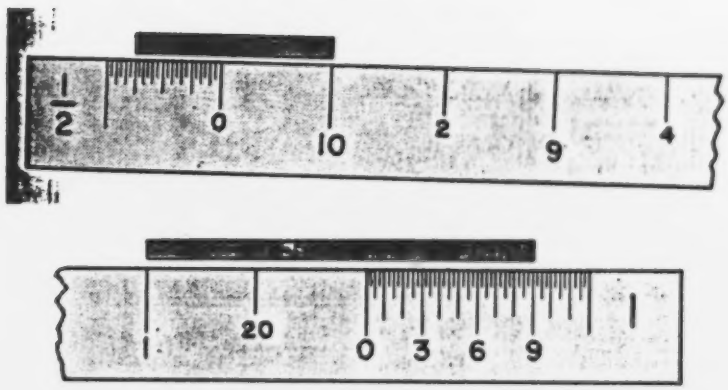


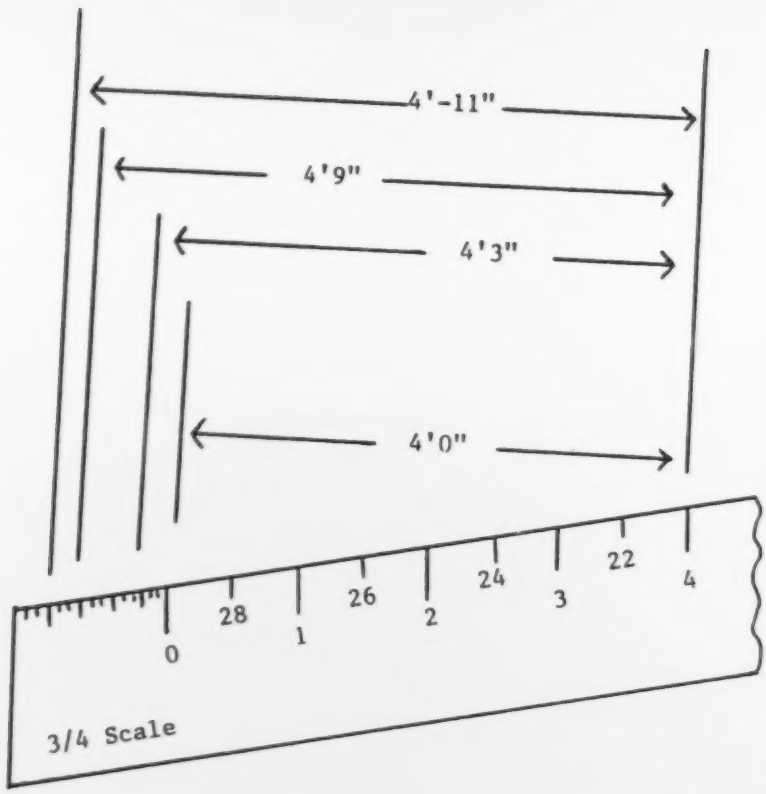




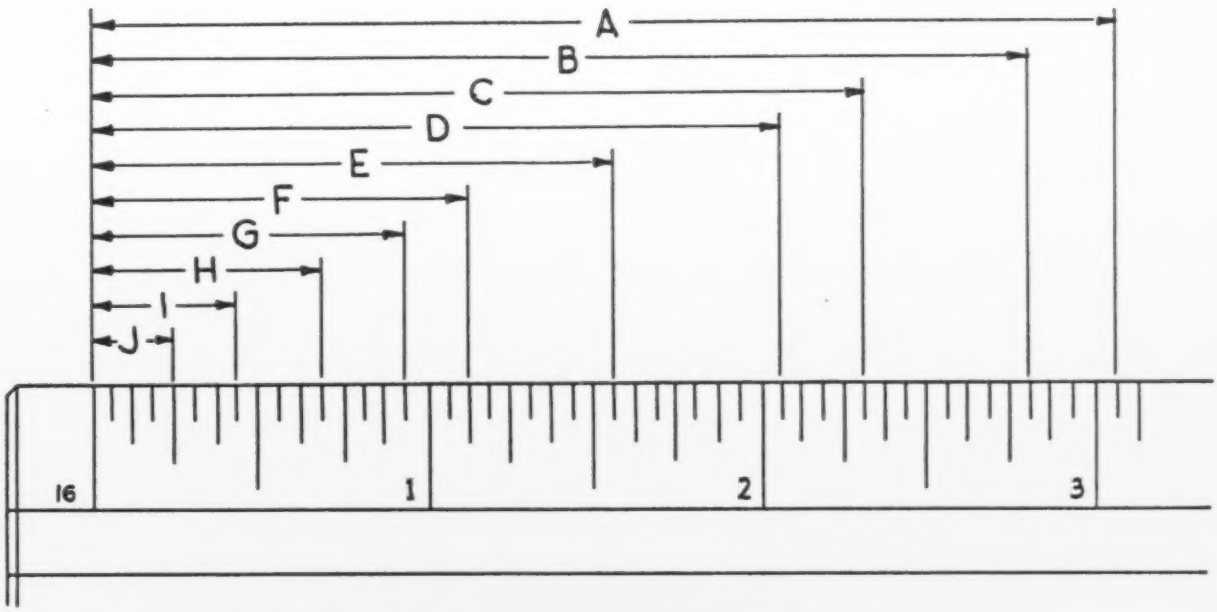
1′ 9″ AS IT APPEARS ON SEVERAL ARCHITECT'S SCALES.





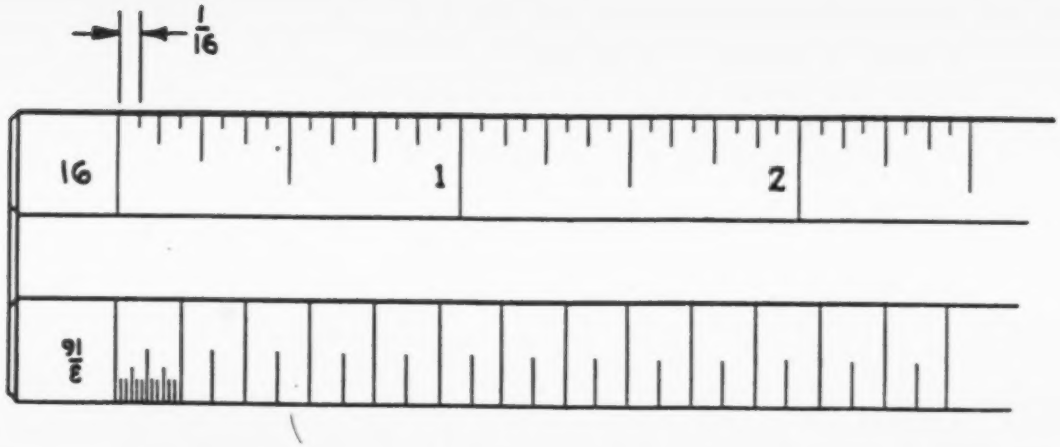

4'-11"
4'9"
4'3"
4'0"
0
28
1
26
2
24
3
22
4
3/4 Scale

RULER REVIEW

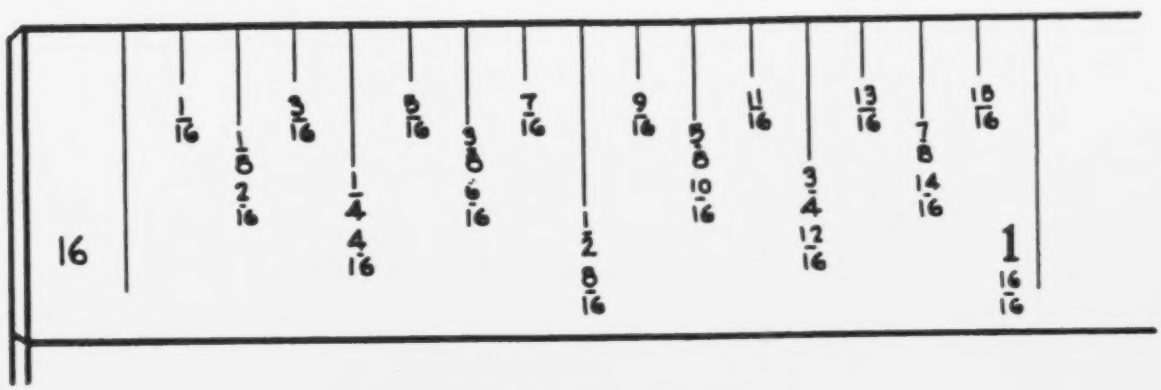


HOW MANY CAN YOU ANSWER CORRECTLY?

THE DIVISIONS OF THE RULER



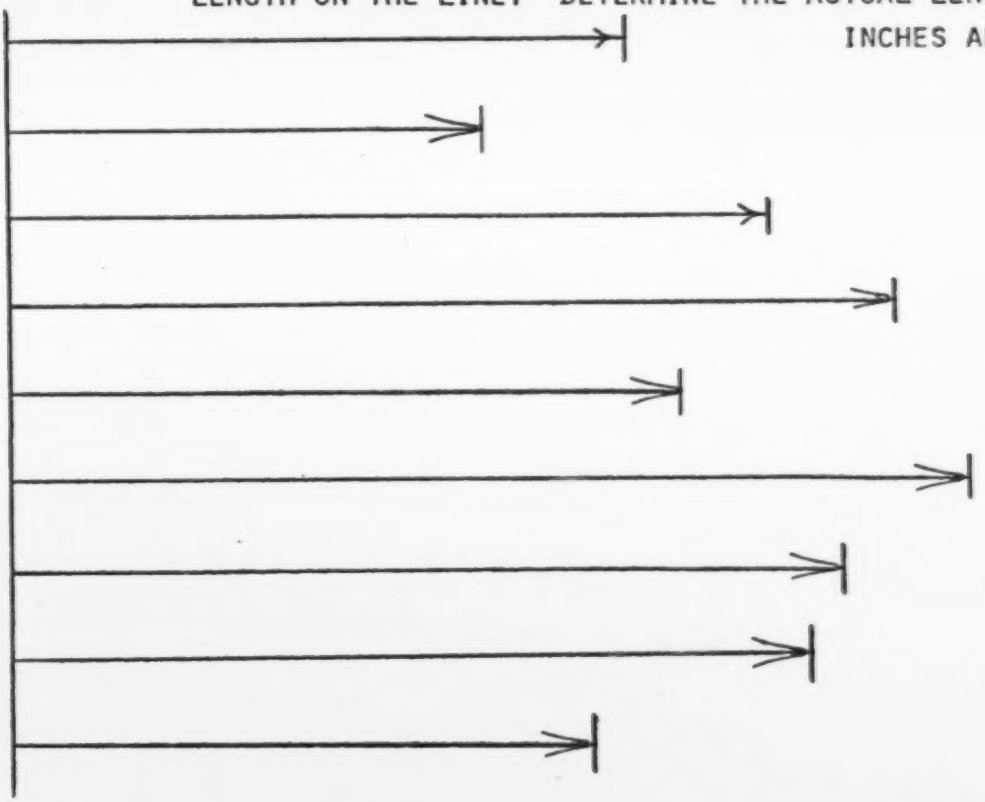
THE 1/16 GRADUATED EDGE



THE DIVISIONS NUMBERED

SCALE PRACTICE SHEET

DIRECTIONS: MEASURE CAREFULLY EACH OF THE LINES ACCORDING TO THE SCALE INDICATED. DRAW GUIDE LINES AND LETTERS NEATLY. PLACE ARROWHEADS AT THE END OF EACH LINE. PLACE ACTUAL LENGTH ON THE LINE. DETERMINE THE ACTUAL LENGTH IN INCHES AND FEET.



NAME: _____

DATE: _____

CLASS: _____

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 6: Multiview Drawings

Need:

The detail of an object is often difficult to show on a single 3-dimensional picture on a sheet of paper. Every object has six directions of sight. Most objects can be completely dimensioned using three views. Since mechanical drawing is a universal graphic language, knowing how to place these views on a drawing will enable you to communicate clearly through drawings.

References:

Modern Agricultural Mechanics, Wakeman.
Working in Agricultural Mechanics, Shinn

Objectives:

Given the basic drawing equipment, material and several pre-cut dimensioned wooden blocks, the students will be able to:

a. Center multiview drawing on the drawing sheet.
b. Draw and dimension 3-view isometric drawings.

Interest Approach:

Share the sketch on OH 1. Ask the students to locate the 6 possible views. Then have them discuss what the 3-view, front, top and side will look like on a flat sheet of paper. It would be helpful if the students had an actual model to view.

Key Questions, Problems or Concerns	Teaching, Techniques and Procedures
1. How many possible views of an object might we be able to see?	a. Front, top, right side, left side, rear and bottom views. b. Refer back to OH 1 or model. c. Discuss OH 2. Be sure to explain why three of the views are actually duplicates.
2. How should the three views be placed on the drawing sheet.	a. In most cases one, two or three views are sufficient to describe the shape of an object.

b. Views containing a large number of hidden lines should be eliminated since the hidden lines will make a drawing confusing.

c. Each view of an object will show a minimum of two dimensions.

d. Any two views will have at least one dimension in common.

e. It saves time if we can project from one view to the other instead of measuring.

f. Construction lines should be used when transferring points.

g. Discuss OH 3.

3. How do you center a 3-view isometric drawing.

a. Give each student a copy of the Task Operation Sheet entitled, "Centering a 3-View Drawing". Take them through the exercise.

Application and Followup:

Prepare a large number of wooden blocks of a standard size, but with a variety of configurations. These blocks can be prepared quickly with the table saw and band saw. A suggested size is 4" long, 2" high and 2" wide. These blocks can be given to the students for making their practice drawings. Following their activity, they should be given simple objects to draw, perhaps their projects that they will be building in the shop.

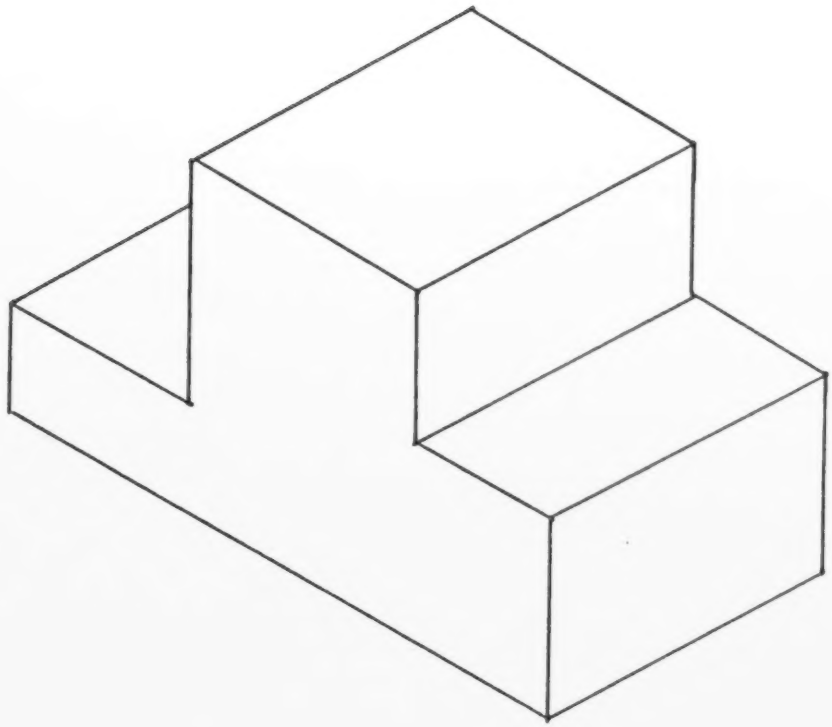
TASK OPERATION SHEET

Task: Centering a 3-View Drawing

Steps	Standard Operating Procedure	Safety & Key Points
1. Gather Equipment	a. T-square, pencils, eraser, drawing pen, masking tape, scale.	
2. Examine the object to be drawn.	a. Determine its width, depth & height. b. Determine the position in which the object will be drawn. (Figure 1)	a. Determine the scale size of the object to be drawn.
3. Center the views on the sheet horizontally.	a. Measure the area of sheet after the title block and border has been drawn. b. Allow 1" between the front and top views. c. Add the width of front view, plus the depth of side view, plus 1" space between views (Fig. 1). (4" + 1 1/2" + 1" = 6 1/2") d. Subtract this total from the horizontal width of the working surface and divide by 2. (10 1/2" - 6 1/2" = 3 3/4" - 2 = 1 7/8"). e. Measure in 1 7/8" from the left border line & draw a vertical construction line. f. Measure over the distance equal to the width of the front view and draw a second vertical construction line (Fig. 2).	a. The area should be 7" x 10 1/2" when using 8 1/2" x 11" paper.
3. Center the views on the sheet vertically.	a. Allow 1" space to separate the views. b. Add the height of the front view plus the width of the top view plus 1" space. (Fig. 1) (2" + 1 1/2" + 1" = 4 1/2")	a. Use the same area of the drawing paper.

	c. Subtract this total from the vertical height of the working surface and divide by two. (7 - 4 1/2 = 2 1/2" - 2 = 1 1/4")
	d. Measure the 1 1/4" from bottom and top border line and draw construction lines. (Fig. 3)
4. Locate the end view.	a. Draw a 45 degree angle from the upper left corner of the front view. (Fig. 4)
	b. Complete the border lines for the end view.
5. Complete the drawing.	a. Complete the object lines, hidden lines, center lines, etc. for the block shown in Fig. 5.

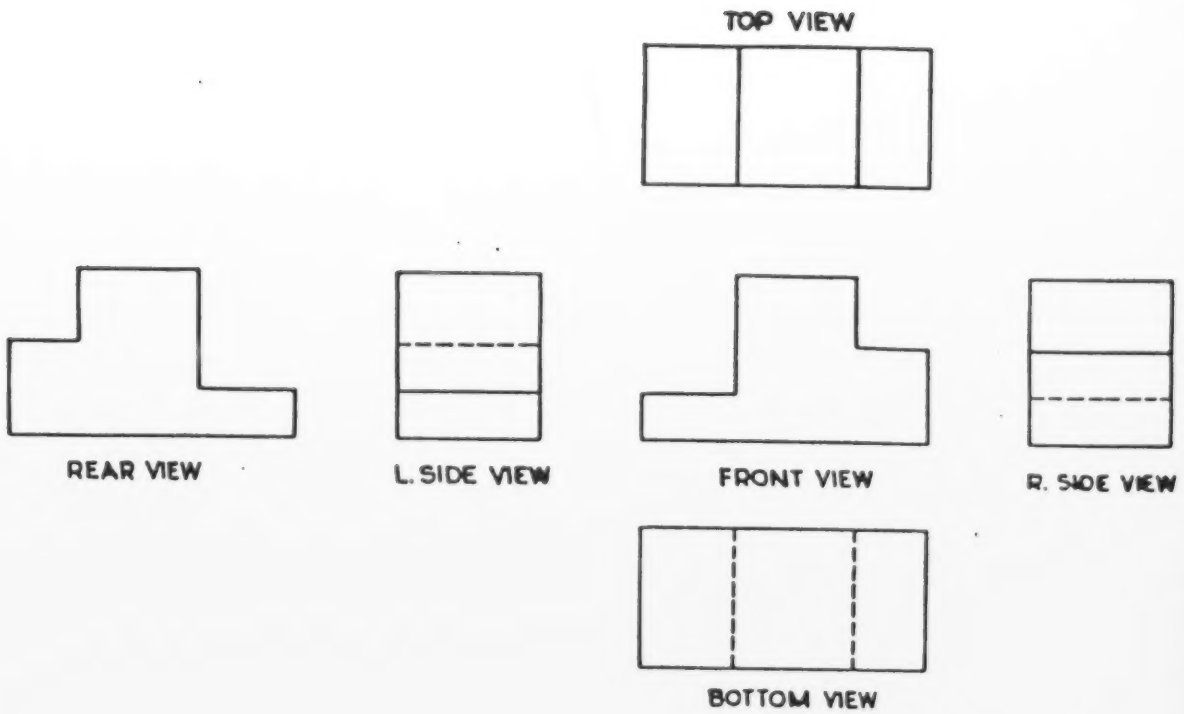
THE SIX DIRECTIONS OF SIGHT



DRAW A LINE TO THE CORRECT VIEW.

TOP VIEW
LEFT SIDE VIEW
REAR VIEW
BOTTOM VIEW
FRONT VIEW
RIGHT SIDE VIEW

SIX POSSIBLE VIEWS



TRANSFERRING POINTS

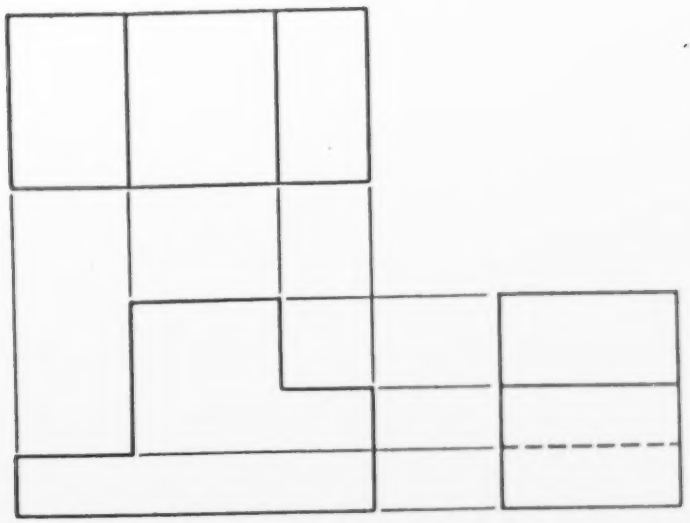
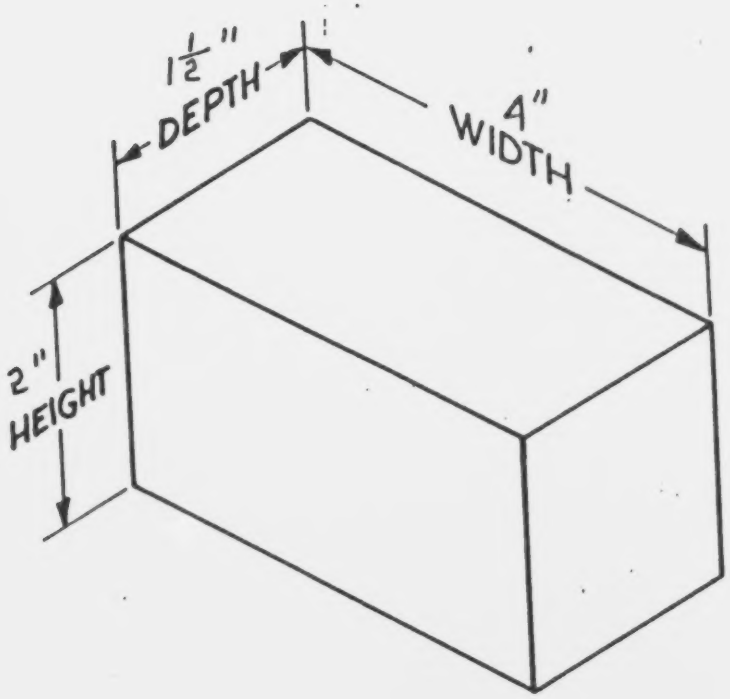
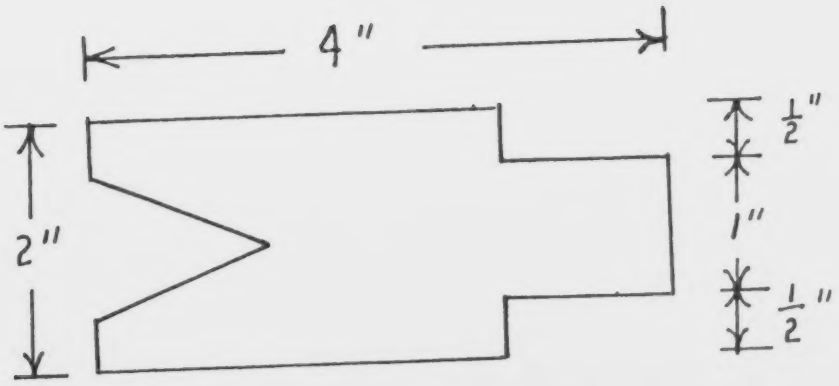


FIG. 1





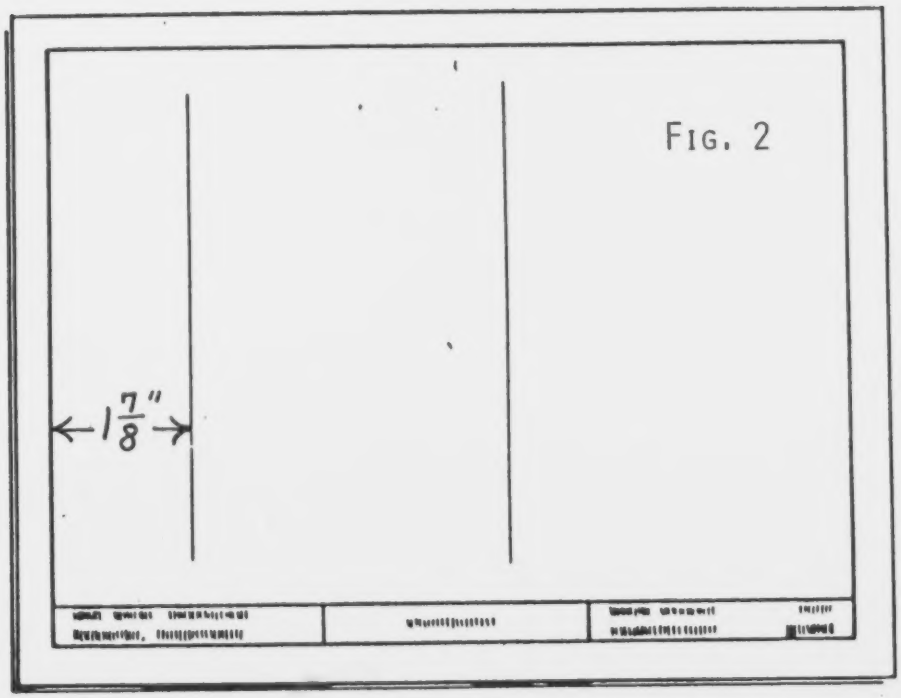


FIG. 2

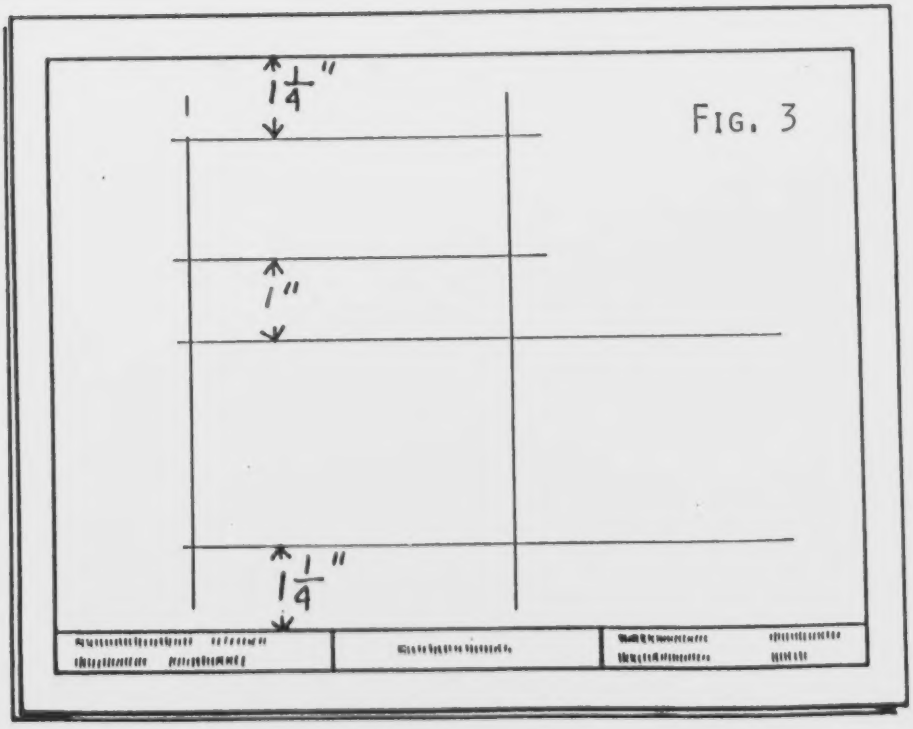


FIG. 3

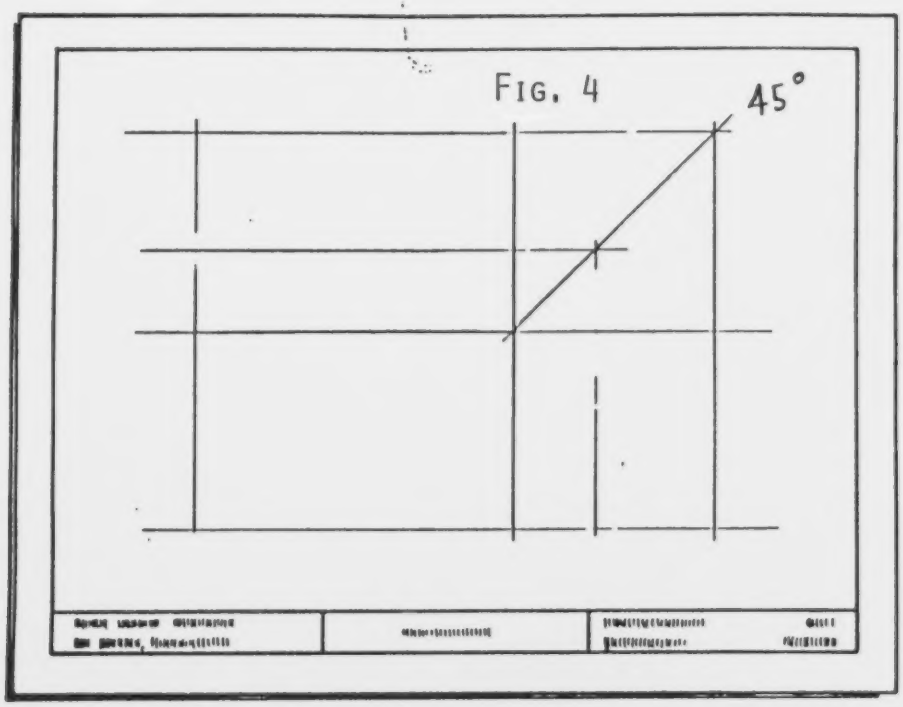


FIG. 4
45°

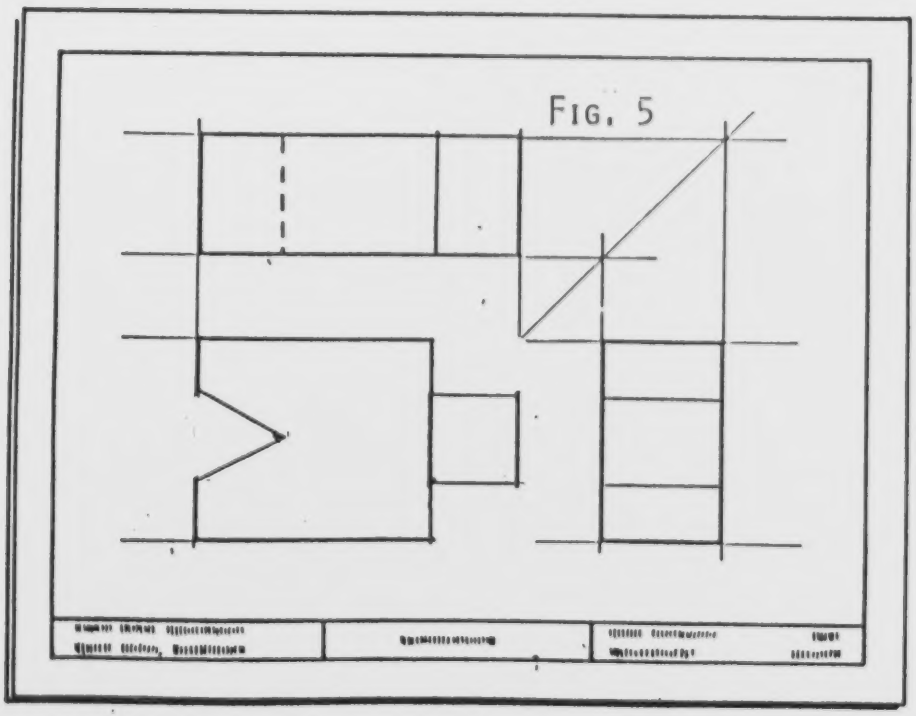


FIG. 5

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 7: Dimensioning of a Drawing

Need:

This skill is one of the most important in drawing and sketching. The proper use of dimension lines is necessary to avoid confusion throughout the entire process.

References:

Modern Agricultural Mechanics, Wakeman

Objectives:

Given the basic drawing equipment, materials and a simple object, the students will be able to:

1. Center the object on the drawing paper.
2. Dimension the drawing properly.
3. Dimension a drawing of a single project.

Interest Approach:

Give the students a complete drawing of a simple project such as a sawhorse. With the completed project visible, have the students identify the dimensions of the various parts of the sawhorse without measuring.

Key Questions, Problems, and Concerns	Teaching Techniques and Practices
1. There are two generally approved ways of dimensioning a drawing.	a. Letter the dimension so they are read from the bottom or the right of the sheet. b. Dimensions are easier to read from the bottom of the sheet. (OH 1)
2. What are some generally accepted procedures for drawing dimensions?	a. Extension lines 1. They should extend 1/8" beyond the last dimension line. 2. They do not touch the drawing. 3. The smaller or detail dimensions are nearest the view.

4. Unless absolutely necessary, dimensions should not be placed within the views (OH #2).

b. When dimension lines are capped with arrowhead, they should be carefully drawn. (OH #3)

c. If possible, all dimensions should be grouped together rather than scattered about the drawing. (OH #4)

d. Circles or holes are dimensioned by dividing the diameter. (OH #3)

e. Arcs are dimensioned by giving the radius. (OH #6)

f. Plan your work carefully to eliminate repeating dimensions. (OH #7)

g. Angles are dimensioned according to their size. (OH #8)

h. When the space between extension lines is too small to place both the arrowhead and the numeral, dimensions may be indicated in various ways. (OH #9)

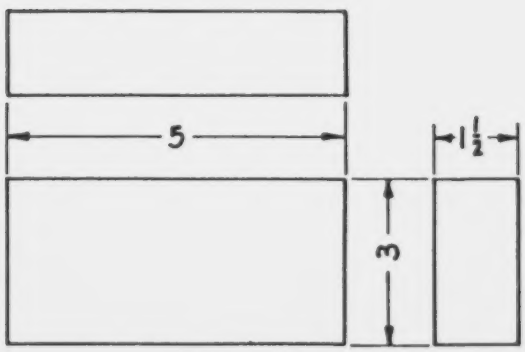
i. Be sure to include detail and overall dimensions. (OH #10)

j. Numerals and fractions must be drawn in proper relation to one another (OH #11)

Application and Followup:

There are two worksheets that accompany this lesson. These worksheets will enable the students to apply the principles of dimensioning presented in this lesson. The teacher could construct both objects and/or give some of the dimensions depending on the ability of the numbers of the class.

READING DIMENSIONS



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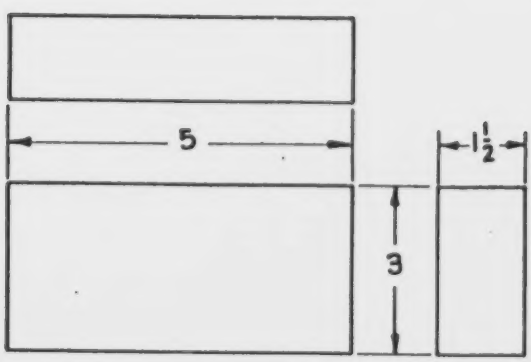
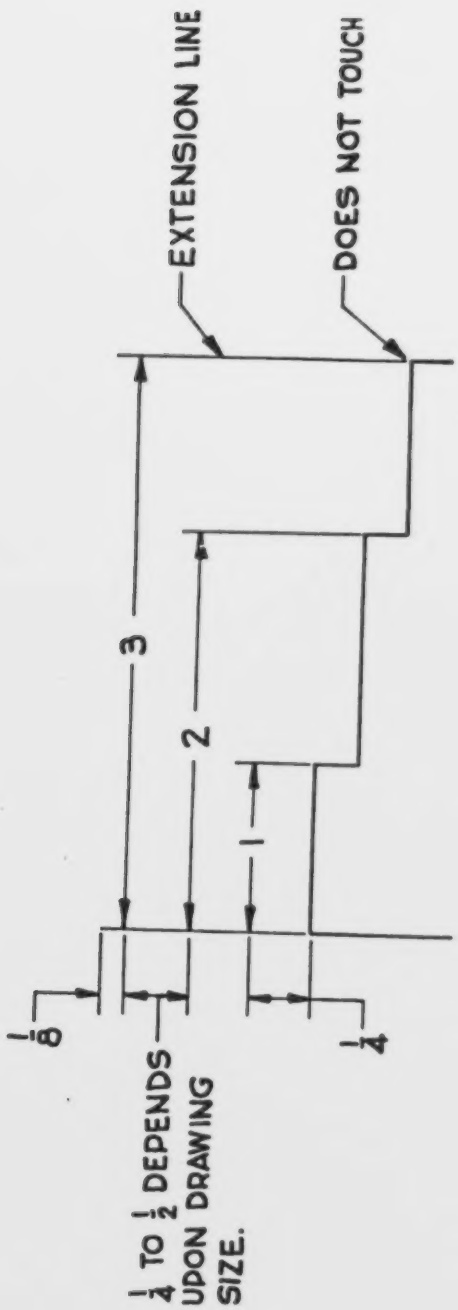


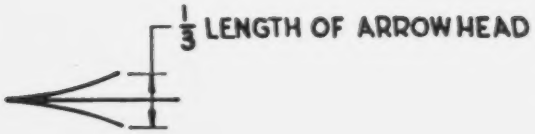
LIKE THIS

DIMENSION LETTERED TO READ FROM THE BOTTOM

DRAWING EXTENSION LINES

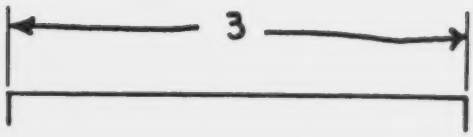


WHEN DIMENSION LINES ARE CAPPED WITH ARROWHEADS



DO THIS

NOT THIS



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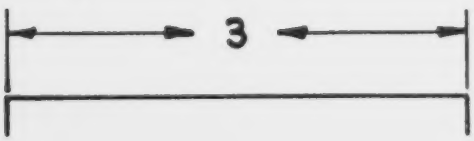
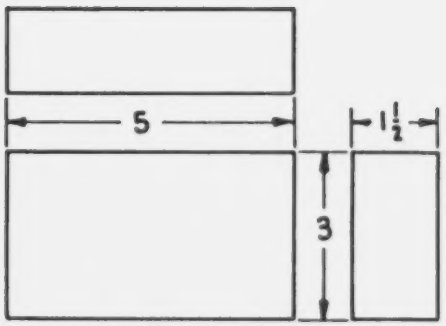


OR THIS

GROUP DIMENSION LINES



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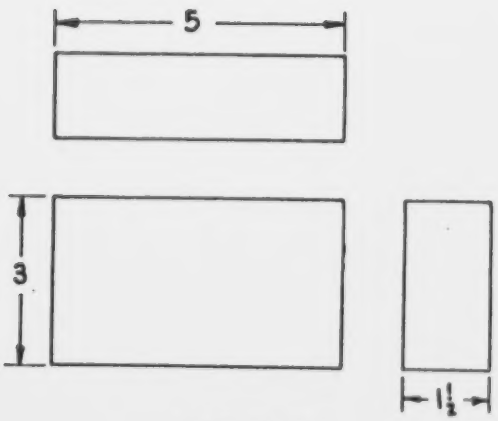
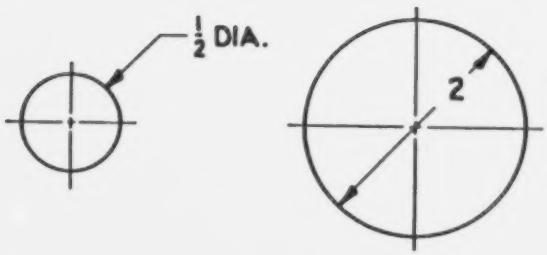
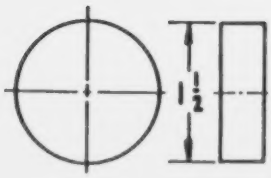


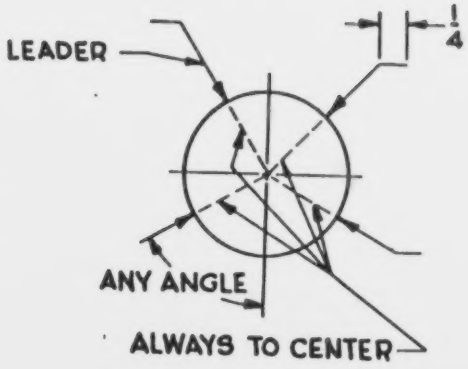
NOT THIS

DON'T SCATTER THE DIMENSION LINES.

DIMENSIONING CIRCLES

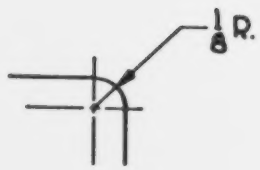


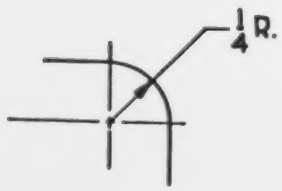


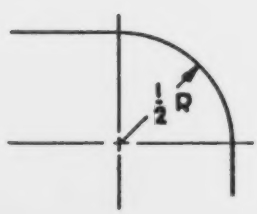


CIRCLES AND HOLES ARE DIMENSIONED BY GIVING THE DIAMETER.

DIMENSIONING ARCS

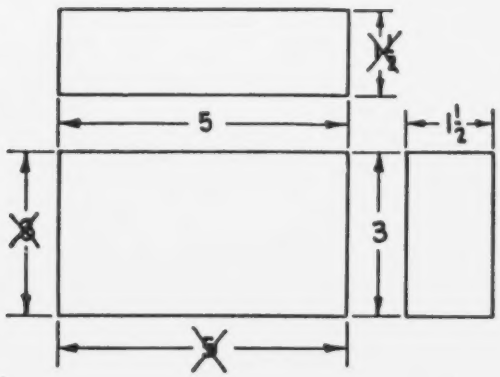


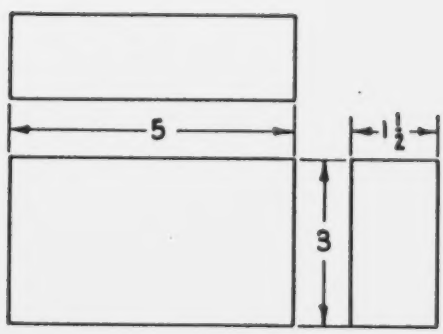




ARCS ARE DIMENSIONED BY GIVING THE RADIUS.

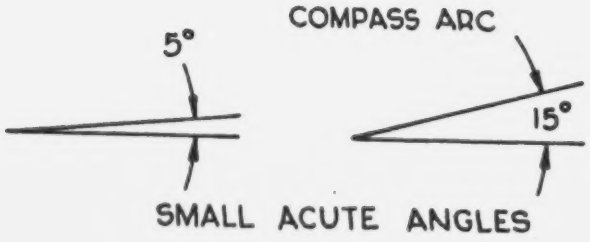
PLANNING FOR DIMENSION LINES

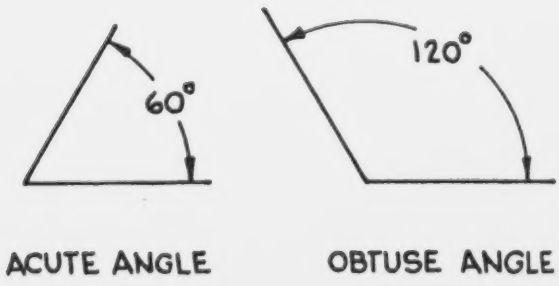




ELIMINATE REPEATED DIMENSION LINES

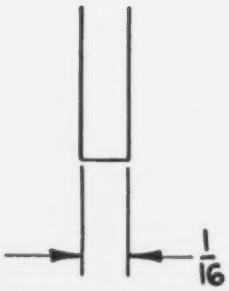
DIMENSIONING ANGLES

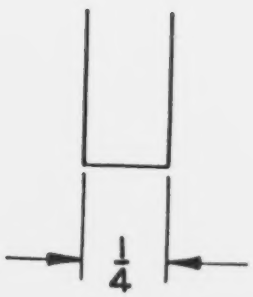


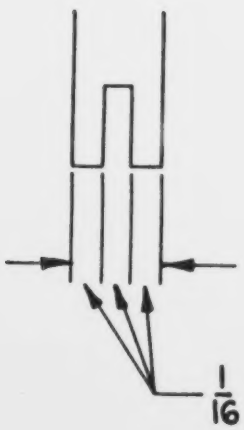


DIMENSION ANGLES ACCORDING TO THEIR SIZE

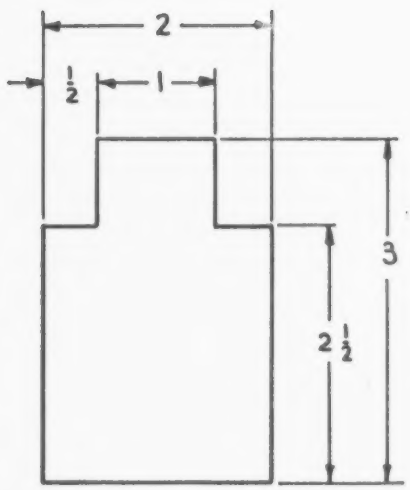
EXTENSION LINES IN SMALL SPACES



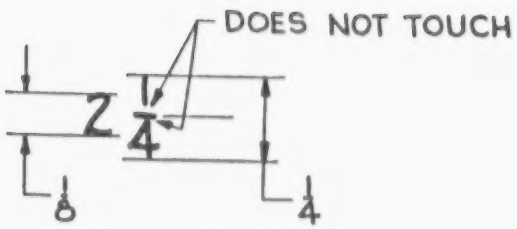


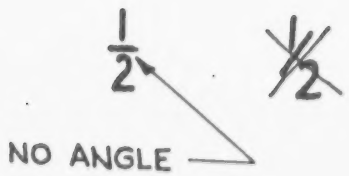


DETAIL AND OVERALL DIMENSION

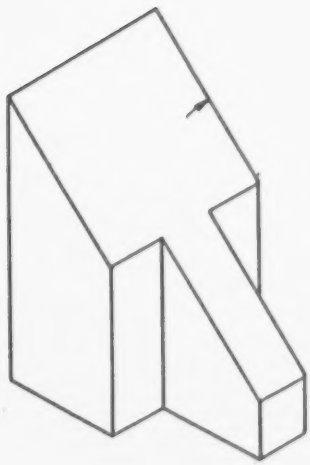


DIMENSIONING NUMBERS AND FRACTIONS

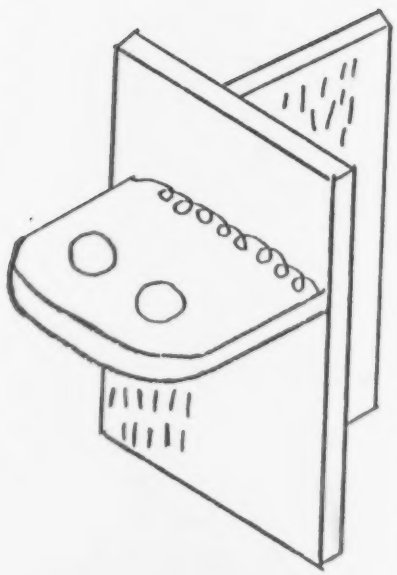




WORKSHEET 1



WORKSHEET 2



UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 8: Reading and Interpreting Plans

Need:

Often, plans that we use have been drawn by others. Since an area (surface) on a drawing can be interpreted in several different ways, it is necessary for the builder to observe other views in order to determine which interpretation is correct. To be accurate in reading plans one must practice.

References:

Modern Agricultural Mechanics, Wakeman
Working in Agricultural Mechanics, Shinn, Weston

Objectives:

Given several different simple working drawings the students will be able to identify the shape, dimensions and material used to construct the object.

Interest Approach:

Give the students a 3-view drawing of a simple project. Don't let them see the actual object. Have them form or make the object out of clay. After a period of time show them the actual object.

Key questions, problems, or concerns	Teaching techniques and procedures
1. Reading Plans	a. Read the title carefully. a. Glance over the drawing to get general idea of the shape. b. Study the view that shows the most characteristic shape. 1. Look at the other views to determine what each line represents. 2. A line indicates the intersection of two surfaces, the edge view of a receding surface or a contour.

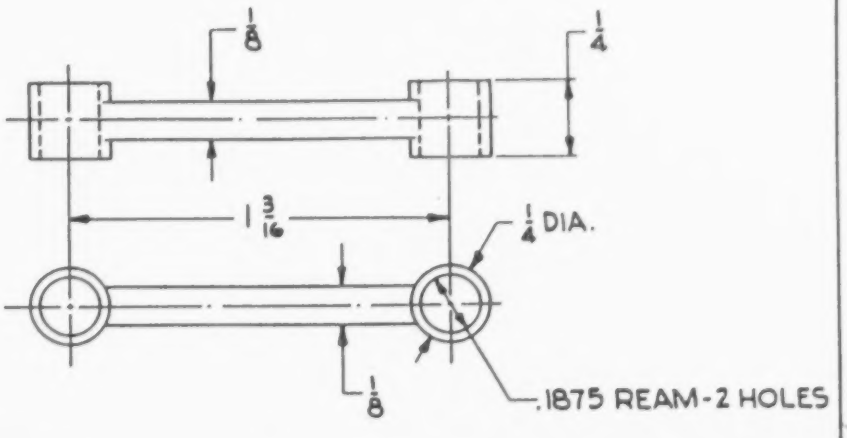
	3. When looking at a view always try to picture the object itself. a. Read the drawing one line at a time.
2. Interpreting Lines	a. Give each student a copy of student exercise one. Identify the following types of lines and tell what they mean or what parts of the object they represent: (OH-1) 1. Visible lines in all views. 2. Hidden or invisible lines in the top and side views. 3. Center lines in all views. 4. Dimension lines in all views. 5. Broken lines to shorten the section in the front and top views.
3. Steps in Reading Dimension	a. The following procedures will be helpful in reading and understanding the dimensions of a drawing. 1. Determine the scale and size of object. 2. Read individual dimensions. If a dimension does not appear in one view look in some other view.
4. What symbols are used to represent common materials?	a. Use OH-2 when discussing the various symbols.

Application and Followup

Provide the students with a series of single working drawings. Preselect certain dimensions for them to locate and describe.

WORKING DRAWING

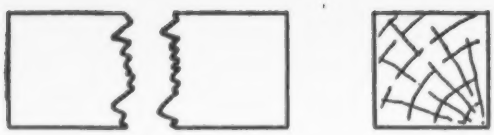
1976 A



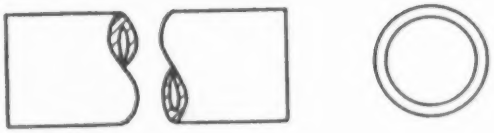
			MINIATURE ENGINES INC. BEL AIR, MARYLAND		
			CONNECTING ROD		
			DR. BY: J.R.W	MAT.: 24ST ALUM.	
2001 A	DRAGON	PISTON ASSEMBLY	CKD. BY. E.J.P.	APP. BY: JK	A
PART NO.	MODEL	NAME	SCALE: 2:1	8/28	SHEET 3
NEXT ASSEMBLY					

1976 A

CONVENTIONAL BREAKS

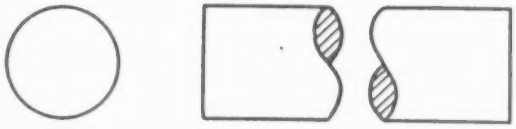


SQUARE WOOD SECTION



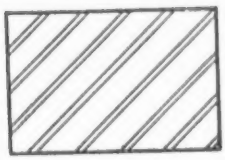
PIPE AND TUBING

SQUARE SECTION

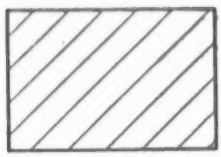


ROUND SECTION

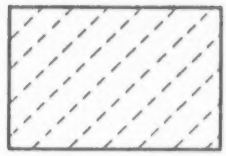
COMMON SYMBOLS USED FOR CONSTRUCTION SYMBOLS



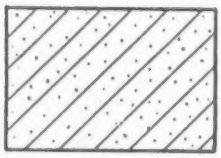
STEEL



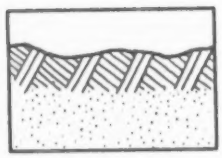
BRICK & STONE



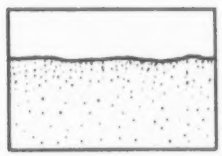
GLASS



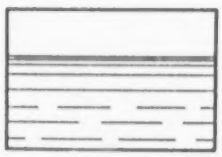
BUILDING BLOCK



ROCK

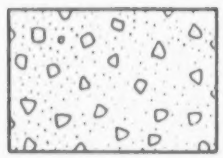


SAND



WATER

WOOD



CONCRETE

UNIT: Drawing and Sketching in Agricultural Mechanics

Lesson 9: Figuring a Bill of Material

Need:

An important part of any construction project large or small is the determination of the material costs. All projects, regardless of their size or complexity should first be drawn on paper and the cost determined. Many projects are started and never completed because the worker failed to calculate the cost.

References:

Modern Agricultural Mechanics, Wakeman
Working in Agricultural Mechanics, Shinn and Weston
Mechanics in Agriculture, Phipps

Objectives:

Given a 3-view orthographic drawing or perspective drawing of a common shop project, the students will be able to calculate an accurate cutting bill and order bill for that project.

Interest Approach:

Have a student project available. Give the class a few minutes to list all the specific items that will need to be considered to figure the final cost. Have the group estimate the cost of the project.

Key Questions, Problems or Concerns	Teaching Techniques and Procedures
1. Why is a bill of material so important.	a. Avoid waste. b. Reduce cost c. Save time. d. For planning purposes. e. Etc.
2. What is the difference between a Cutting Bill and an Order Bill.	a. Cutting Bill: A list of each item needed and its exact length. (Give examples) b. Order Bill: This bill is prepared by combining materials and arranging them in a list with the largest materials heading the list.

1. Example: The cutting bill may call for five (5) 2" x 4" x 5′ pieces of lumber. However, the lumber yard does not sell odd lengths. In this case it may be best to order 10′ lengths and cut them to avoid waste.
2. The order bill also combines hardware items.

3. Key things to remember when ordering lumber.
   a. Dimension lumber is sold in standard lengths and priced by the board foot.
   b. Plywood material is sold by the square foot.
   c. Trim is sold by the running foot.
   d. Dimension lumber is priced by the 1000 board foot. ($/M)

4. How do you calculate board feet?
   a. Board foot formula.

$$\text{Bd. Ft.} = \frac{\text{No. Pcs.} \times \text{T"} \times \text{W"} \times \text{L′}}{12}$$

or

$$\text{Bd Fd.} = \frac{\text{No. pcs.} \times \text{T"} \times \text{W"} \times \text{L′}}{144}$$

   b. Work a couple of practice problems with the students. Problem worksheet is included.

Application and Followup:

A perspective drawing of an open type sawhorse is included in this lesson. Have the students prepare a cutting bill and an order bill for the sawhorse. The teachers should be prepared to supply the material prices.

BOARD FOOT PROBLEMS

NAME: _____ SCORE _____

1. AT $750 A THOUSAND BOARD FEET, HOW MUCH WILL ONE BOARD FOOT COST?

2. AT $578 A THOUSAND, HOW MUCH WILL 100 BOARD FEET COST?

3. HOW MUCH WILL 125 BOARD FEET COST AT $800 A THOUSAND?

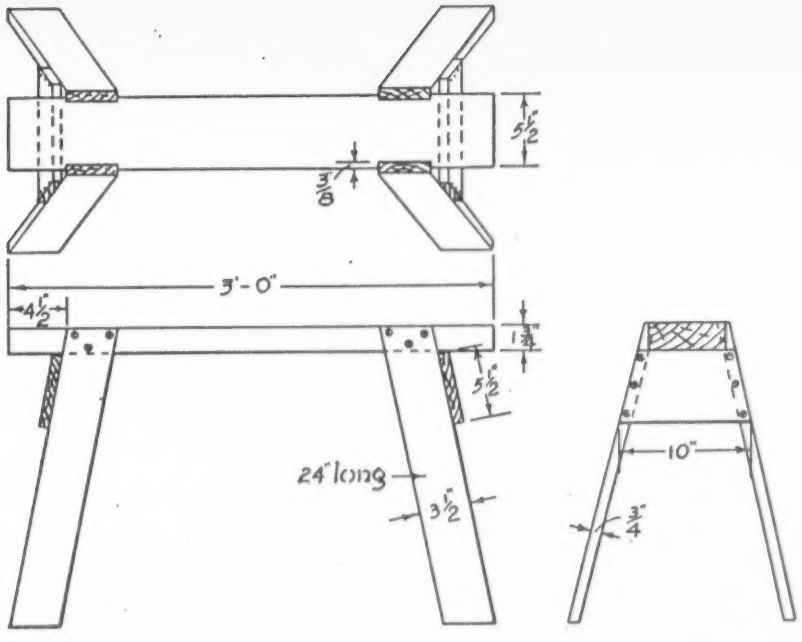
4. HOW MANY BOARD FEET ARE THERE IN A 2 x 6 MEASURING 12 FEET LONG.

5. HOW MANY BOARD FEET ARE THERE IN EIGHTEEN 16 FOOT 2 x 4'S?

6. HOW MANY BOARD FEET ARE THERE IN 350 LINEAL FEET OF 2 x 8?

7. A BOARD MEASURES 3½" THICK, 7¼" WIDE, AND 16' LONG.
   A. WHAT DIMENSION LUMBER WILL YOU BE CHARGED FOR?
   B. HOW MANY BOARD FEET WILL THERE BE IN 60 OF THESE BOARDS?
   C. HOW MUCH WILL THIS COST AT $575 A THOUSAND?

STUDENT WORKSHEET



CUTTING BILL:

		Cost
4 EACH	LEGS	
2 EACH	BRACES	
1 EACH	TOP	
12 EACAH No. 8 x 2½" WOODSCREWS		
	TOTAL	

ORDER BILL:

		Cost
	LEGS	
	BRACES	
	TOP	
	SCREWS	
	TOTAL	